No title available

Publication number: JP5240371
Publication date: 1993-09-17
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Classification:
- international: ***F03G7/06; F16K31/68; G01N30/26;*** **F03G7/06; F16K31/64; G01N30/00;** (IPC1-7): F16K31/68; F03G7/06; G01N30/26
- European:
Application number: JP19920037793 19920225
Priority number(s): JP19920037793 19920225

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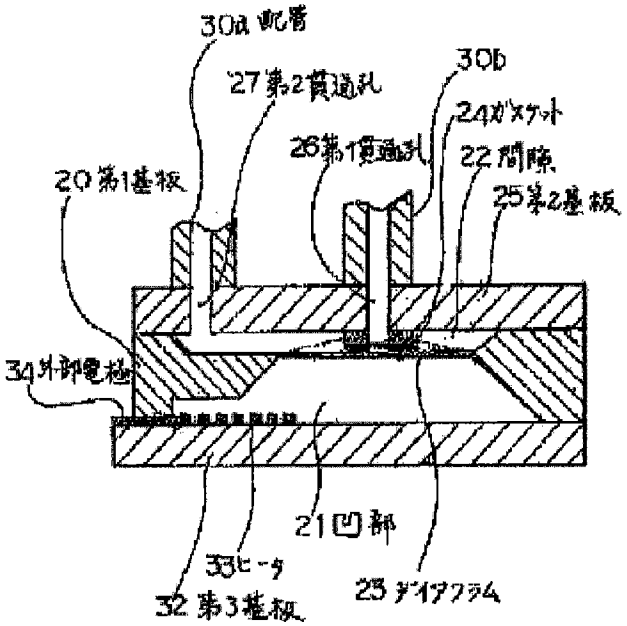
Abstract of **JP5240371**

PURPOSE:To provide a micro-valve which is excellent in long-term stability and can drive plural valves at one time with a simple structure. CONSTITUTION:This micro-valve is provided with the first base board 20 where a recessed part 21 is formed in one surface and a diaphragm 23 is formed in the other surface of the recessed part 21, and at least one ring-shaped gasket 24 which is fixed on the diaphragm 23. It is provided with the first through hole 26 which is arranged in an air tight condition at a prescribed interval 22 on the side where the diaphragm 23 of the first base board 20 is formed, and formed at a position facing the approximate center of the gasket 24, the second base board 25 which is formed at a position facing the outer periphery of the gasket 24 and provided with at least one second through hole 27, and the third base board 32 which covers the recessed part 21 and is arranged in an air tight condition. An expanding (or contracting) member is enclosed in the recessed part 21 by heating (or cooling) to provide a means for heating (or cooling) the member.



Family list
1 family member for: **JP5240371**
Derived from 1 application

Back to JP524037

1 **No title available**
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EC:
IPC: ***F03G7/06; F16K31/68; G01N30/26*** (+6)
Publication info: JP5240371 A - 1993-09-17

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(19)日本国特許庁（ＪＰ）　(12) **公開特許公報（A）**　(11)特許出願公開番号

特開平5－240371

(43)公開日　平成５年(1993)９月17日

(51)Int.Cl.[5]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｆ１６Ｋ　31/68	Ｚ	9179－3Ｈ		
Ｆ０３Ｇ　7/06	Ｊ	7713－3Ｇ		
Ｇ０１Ｎ　30/26	Ｍ	8506－2Ｊ		

審査請求　未請求　請求項の数１(全　4　頁)

(21)出願番号　特願平4－37793

(22)出願日　平成４年(1992)２月25日

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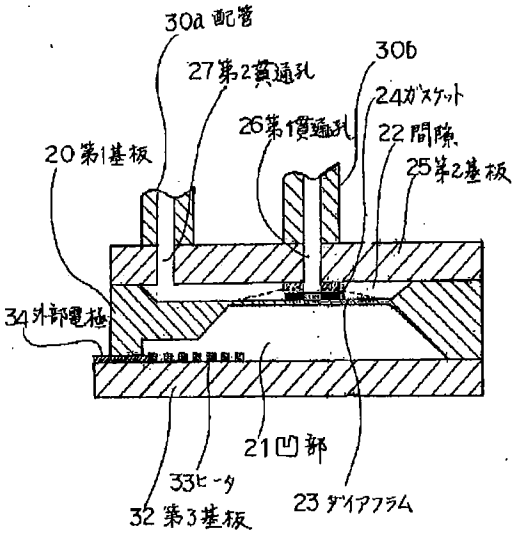
(54)【発明の名称】　マイクロバルブ

(57)【要約】

【目的】　長期安定性にすぐれ，簡単な構成で複数のバルブを同時に駆動することが可能なマイクロバルブを提供する。

【構成】　一方の面に凹部が形成され，該凹部と他方の面でダイアフラムが形成された第１基板と，前記ダイアフラム上に固定された少なくとも一つのリング状のガスケットと，前記第１基板のダイアフラムが形成された側に所定の間隙を有して気密に配置され，前記ガスケットのほぼ中心に対向する位置に形成された第１貫通孔及びガスケットの外周に対向する位置に形成された少なくとも一つの第２貫通穴を有する第２基板と，前記凹部を覆って気密に配置された第３基板とを有し，前記凹部に加熱（若しくは冷却）により膨張（若しくは収縮）する部材を封入するとともに，該部材の加熱（若しくは冷却）手段を設ける。



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【特許請求の範囲】

【請求項1】　一方の面に凹部が形成され，該凹部と他方の面でダイアフラムが形成された第1基板と，前記ダイアフラム上に固定された少なくとも一つのリング状のガスケットと，前記第1基板のダイアフラムが形成された側に所定の間隙を有して気密に配置され，前記ガスケットのほぼ中心に対向する位置に形成された第1貫通孔及びガスケットの外周に対向する位置に形成された少なくとも一つの第2貫通穴を有する第2基板と，前記凹部を覆って気密に配置された第3基板とを有し，前記凹部に加熱（若しくは冷却）により膨張（若しくは収縮）する部材を封入するとともに，該部材の加熱（若しくは冷却）手段を設けたことを特徴とするマイクロバルブ。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は，例えばシリコン基板上に形成された超小型ガスクロマトグラフィのガス流路切替えに用いて好適なマイクロバルブに関するものである。

【0002】

【従来の技術】従来，この種のマイクロバルブとしては実開平1－154460に記載された図4に断面で示す構造のものが知られている。図4において，1はシリコンからなる第1基板であり，このシリコン基板1にはエッチングにより形成された中央部にメサ部6を有するダイアフラムが形成され，このダイアフラムを形成する凹部に連通して溝7が形成されている。2はパイレックスガラスからなる第2の基板で，メサ部6と溝7の位置に合わせて流体の出入口となる貫通孔9，10が形成されており，第1，第2の基板は陽極接合により重ねて形成されている。

【0003】4は断面コ字状の支持部材であり，第1の基板1に形成されたメサ部6の裏面を覆って接着剤により固定されている。5は圧電アクチュエータ（以下，単にアクチュエータという）で，このアクチュエータ5は一端が支持部材4の底部に，他端が第1基板のメサ部6の裏面に接して配置されている。12はアクチュエータに電圧を印加するための電源である。

【0004】なお，第1の基板の厚さは0．3mm，第2の基板の間隙Dは6μm程度であり，アクチュエータの断面は4．2mm²，長さ9mm程度とされ150Vの電圧により8μm程度変位する。

【0005】上記の構成のバルブによれば，アクチュエータ5の電源12がオフの時に流体が貫通孔9から流入して貫通孔10側へ流れ，電源12がオンの時はアクチュエータ5が伸長してメサ部6により流出孔10を閉塞するので，ノーマリオープン型のバルブを実現することができる。

【0006】

【発明が解決しようとする課題】しかしながら，上記従

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来のマイクロバルブは圧電アクチュエータの伸長距離が極めて短いため調整が難しく，また，アクチュエータを接着により固定しているため長期安定性に問題がある，さらに，バルブの集約，駆動回路，流量測定，検出器等の他の機能の一体化をはかる場合，シリコン微細加工技術によりバルブを同時に形成することは困難である。また，それぞれのバルブ1個に対し一つの駆動装置が必要となるのでコスト高になるという問題がある。本発明は上記従来技術の問題点を解決するためになされたもので，ダイアフラムを駆動する手段として気体の膨張による力を利用することにより，長期安定性にすぐれ，簡単な構成で複数のバルブを同時に駆動することが可能なマイクロバルブを提供することを目的とする。

【0007】

【課題を解決するための手段】上記課題を解決する為に本発明は，一方の面に凹部が形成され，該凹部と他方の面でダイアフラムが形成された第1基板と，前記ダイアフラム上に固定された少なくとも一つのリング状のガスケットと，前記第1基板のダイアフラムが形成された側に所定の間隙を有して気密に配置され，前記ガスケットのほぼ中心に対向する位置に形成された第1貫通孔及びガスケットの外周に対向する位置に形成された少なくとも一つの第2貫通穴を有する第2基板と，前記凹部を覆って気密に配置された第3基板とを有し，前記凹部に加熱（若しくは冷却）により膨張（若しくは収縮）する部材を封入するとともに，該部材の加熱（若しくは冷却）手段を設けたことを特徴とするものである。

【0008】

【作用】通常状態では第1，第2貫通孔は間隙を介して連通し，流路が開（若しくは閉）の状態となっている。第1基板の凹部に封入された部材を加熱（若しくは冷却）手段により加熱（若しくは冷却）すると部材が膨張（若しくは収縮）する。その結果ダイアフラムが撓んでガスケットのほぼ中心に対向して配置された第1貫通孔を閉塞（若しくは解放）し流路は閉（若しくは開）の状態となる。

【0009】

【実施例】以下図面を用いて本発明を説明する。図1は本発明のマイクロバルブの一実施例を示す断面図である。図において20はシリコン単結晶からなる第1基板であり，この第1基板の一方の面には異方性エッチングを用いて凹部21が形成されている。22は第1基板20の他方の側に形成された深さ数μm程度の間隙，23は一辺が100μm～10mm程度，厚さ1～100μm程度のダイアフラムである。24はダイアフラム上に形成された厚さ数μm，外径10μm～1mm程度のニッケルや金等からなるリング状のガスケットで，蒸着，スパッタ等により形成されている。

【0010】25はパイレックスガラスやシリコン単結晶等からなる第2基板であり，この第2基板25にはガ

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スケット２４に対向する位置に第１貫通孔２６が形成され，第１基板２０に気密に固定されている。２７は間隙２２に連通しガスケット２４の外周に形成された第２貫通孔，３０ａ，３０ｂは第１，第２貫通孔２６，２７に接続された内径０．１～１mm程度の配管である。

【００１１】３２はパイレックスガラスやシリコン単結晶等からなる第３基板であり，この第３基板３２の一方の面には金属薄膜抵抗体からなるヒータ３３が形成され，そのヒータ部分が第１基板の凹部内に位置するように気密に固定されている。この凹部の密封に際しては例えばN_2ガスを封入する。３４は外部電極であり，ヒータ３３に電気絶縁層（図示せず）を介して気密に接続されている。

【００１２】上記の構成において，通常状態では第１，第２貫通孔２６，２７は間隙２２を介して連通し，配管３０ａ，３０ｂを通る流体流路は開の状態となっている。そして，外部電極３４に電源（図示せず）を接続してヒータ３３を加熱すると凹部に密封されたN_2が膨張する。その結果ダイアフラム２３が点線で示すように撓んでガスケット２４のほぼ中心に対向して配置された第１貫通孔２６を閉塞し流路は閉の状態となる。

【００１３】図２は他の実施例を示す断面図である。図において図１と同一要素には同一符号を付して重複する説明は省略するが，この実施例においては一点鎖線Ａで示す比較的大きめの凹部２１ａを形成し，この凹部を更にエッチングして比較的に小さな３つの凹部２１ｂ，２１ｃ，２１ｄを形成し，それぞれのダイアフラム２３ａ，２３ｂ，２３ｃにガスケット２４ａ，２４ｂ，２４ｃを形成している。また，この実施例においては第３基板２０ａの外側に密着してペルチェ素子４０を設け，加熱（若しくは冷却）手段を構成している。４１はペルチェ素子を加熱（若しくは冷却）するための電源である。なお，この例においても凹部２１ａ～２４ｄにはN_2ガス等が封入されている。また，シリコン単結晶からなる第１基板２０にＰＮ接合からなる温度検出手段（図示せず）を設け，その温度検出手段からの信号に応じて電源４１のオンオフを行うことも可能である。

【００１４】上記の構成によれば，一つの電源で３つのダイアフラムを駆動することが可能であり一度に３つの流路の開閉が可能である。また，ガスケット２４ａ～２４ｃと第２基板２５ａの間隙２２を適当に調整し，ペルチェ素子４０と温度検出手段からの信号によりN_2の温度を制御すればノルマルクローズのバルブを実現することができ，更にバルブの開閉動作の信頼性と高速化を図ることが可能である。

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【００１５】なお，本発明は上記実施例に限定するものではない。例えば封入部材としてはＡｒガス，ハロゲンガス，ネオンガス，キセノンガスなどでもよく，加熱により気化して体積が膨張する様なものであればよい。更に間隙２２は第２基板側に設けてもよく，図２に示すダイアフラムの数も３つに限ることなく任意であり，第２貫通孔は２つ以上であってもよい。また，図３に示すように第３基板３２に第３貫通孔５０を設け，他方の側にもう一組の第１，第２基板２０，２５を設ければ更に多数のバルブを開閉することが可能である。

【００１６】

【発明の効果】以上実施例とともに具体的に説明したように本発明によれば，ダイアフラムを駆動する手段として気体の膨張による力を利用することにより，長期安定性にすぐれ，簡単な構成で複数のバルブを同時に駆動することが可能なマイクロバルブを実現することができる。

【図面の簡単な説明】

【図１】本発明の一実施例を示すマイクロバルブの断面構成図である。

【図２】本発明の他の実施例を示すマイクロバルブの断面構成図である。

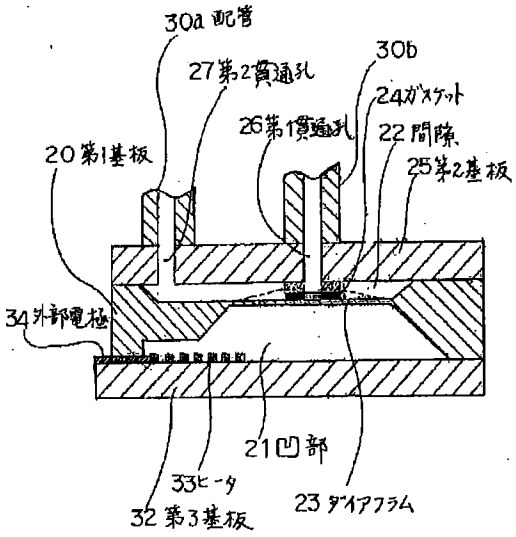
【図３】本発明の他の実施例を示すマイクロバルブの断面構成図である。

【図４】従来のマイクロバルブの断面構成図である。

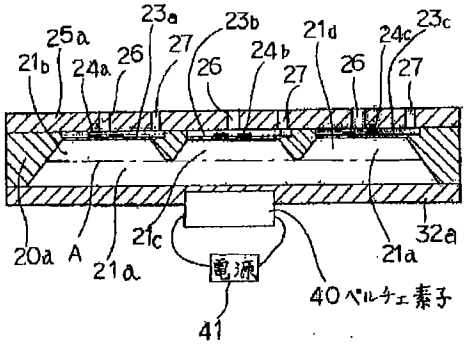
【符号の説明】

２０　第１基板
２１　凹部
２２　間隙
２３　ダイアフラム
２４　ガスケット
２５　第２基板
２６　第１貫通孔
２７　第２貫通孔
３０　配管
３２　第３基板
３３　ヒータ
３４　外部電極
４０　ペルチェ素子
４１　電源

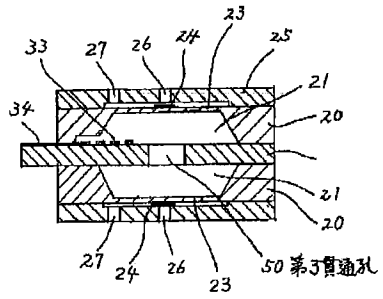
【図1】



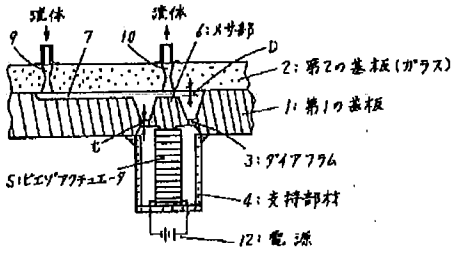
【図2】



【図3】



【図4】



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
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CLAIMS

[Claim(s)]
[Claim 1] The 1st substrate with which the crevice was formed in one field and the diaphragm was formed in respect of this crevice and another side, The gasket of at least one shape of a ring fixed on said diaphragm, It has a predetermined gap in the side in which the diaphragm of said 1st substrate was formed. The 2nd substrate which has 2nd at least one through hole formed in the location which counters the periphery of the 1st breakthrough which has been arranged airtightly and formed in the location of said gasket which counters a core mostly, and a gasket, The micro bulb characterized by establishing the heating (or cooling) means of this member while enclosing the member which has the 3rd substrate which covered said crevice and has been arranged airtightly, and expands with heating (or cooling) to said crevice (or contraction).

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention is used for the gas-passageway change of the micro gas chromatography formed for example, on the silicon substrate, and relates to a suitable micro bulb.
[0002]
[Description of the Prior Art] Conventionally, the thing of the structure shown in drawing 4 indicated by publication of unexamined utility model application Heisei 1-154460 as this kind of a micro bulb in a cross section is known. In drawing 4 , 1 is the 1st substrate which consists of silicon, it is open for free passage to the crevice which the diaphragm which has the mesa section 6 is formed in the center section formed in this silicon substrate 1 of etching, and forms this diaphragm, and the slot 7 is formed. 2 is the 2nd substrate which consists of Pyrex glass, the breakthroughs 9 and 10 which serve as a gate of a fluid according to the location of the mesa section 6 and a slot 7 are formed, and the 1st and 2nd substrate is formed in piles of anode plate junction.
[0003] 4 is the supporter material of a cross-section U shape, covers the rear face of the mesa section 6 formed in the 1st substrate 1, and is being fixed by adhesives. 5 is an electrostrictive actuator (only henceforth an actuator), an end touches the pars basilaris ossis occipitalis of the supporter material 4, the other end touches the rear face of the mesa section 6 of the 1st substrate, and this actuator 5 is arranged. 12 is a power source for impressing an electrical potential difference to an actuator.
[0004] In addition, the thickness of the 1st substrate is about 6 micrometers, and the gap D of 0.3mm and the 2nd substrate is made into 4.2mm 2 and die length of about 9mm, and displaces about 8 micrometers of cross sections of an actuator with the electrical potential difference of 150V.
[0005] Since according to the bulb of the above-mentioned configuration a fluid flows from a breakthrough 9 and flows to a breakthrough 10 side, when the power source 12 of an actuator 5 is OFF, an actuator 5 develops when a power source 12 is ON, and the runoff hole 10 is blockaded by the mesa section 6, the bulb of a NOMARI open type is realizable.
[0006]
[Problem(s) to be Solved by the Invention] However, since the above-mentioned conventional micro bulb has a very short expanding distance of an electrostrictive actuator, adjustment is difficult, and since the actuator is fixed by adhesion, when achieving the unification with the function of others further, such as concentration of a bulb, an actuation circuit, hydrometry, and a detector, which has a problem in long term stability, it is difficult [it] to form a bulb simultaneously with silicon ultra-fine processing technology. Moreover, since one driving gear is needed to each one bulb, there is a problem of becoming cost high. It was made in order that this invention might solve the trouble of the above-mentioned conventional technique, and as a means to drive a diaphragm, by using the force by expansion of a gas, it excels in long term stability and aims at offering the micro bulb which can drive simultaneously two or more bulbs with an easy configuration.
[0007]
[Means for Solving the Problem] The 1st substrate with which, as for this invention, the crevice was

formed in one field, and the diaphragm was formed in respect of this crevice and another side in order to solve the above-mentioned technical problem, The gasket of at least one shape of a ring fixed on said diaphragm, It has a predetermined gap in the side in which the diaphragm of said 1st substrate was formed. The 2nd substrate which has 2nd at least one through hole formed in the location which counters the periphery of the 1st breakthrough which has been arranged airtightly and formed in the location of said gasket which counters a core mostly, and a gasket, It has the 3rd substrate which covered said crevice and has been arranged airtightly, and while enclosing the member which expands with heating (or cooling) to said crevice (or contraction), it is characterized by establishing the heating (or cooling) means of this member.

[0008]

[Function] In the normal state, the 1st and 2nd breakthrough is open for free passage through a gap, and passage is in the open (or close) condition. If the member enclosed with the crevice of the 1st substrate is heated with a heating (or cooling) means (or cooling), a member will expand (or contraction). As a result, a diaphragm bends, the 1st breakthrough of a gasket which countered the core mostly and has been arranged is blockaded (or release), and passage will be in a close (or open) condition.

[0009]

[Example] This invention is explained using a drawing below. Drawing 1 is the sectional view showing one example of the micro bulb of this invention. In drawing, 20 is the 1st substrate which consists of a silicon single crystal, and the crevice 21 is formed in one field of this 1st substrate using anisotropic etching. One side of the gap with a depth of about several micrometers where 22 was formed in the another side side of the 1st substrate 20, and 23 is 100 micrometers - about 10mm and a diaphragm with a thickness of about 1-100 micrometers. 24 is the gasket of the shape of a ring which consists of nickel metallurgy with a micrometers [in thickness / several], and an outer diameter of 10 micrometers - about 1mm formed on the diaphragm, and is formed of vacuum evaporationo, a spatter, etc.

[0010] 25 is the 2nd substrate which consists of Pyrex glass, a silicon single crystal, etc., and the 1st breakthrough 26 is formed in the location which counters a gasket 24, and it is being airtightly fixed to this 2nd substrate 25 by the 1st substrate 20. The 2nd breakthrough which 27 was open for free passage in the gap 22, and was formed in the periphery of a gasket 24, and 30a and 30b are piping with a bore of about 0.1-1mm connected to the 1st and 2nd breakthrough 26 and 27.

[0011] 32 is the 3rd substrate which consists of Pyrex glass, a silicon single crystal, etc., the heater 33 which consists of a metal thin film resistor is formed in one field of this 3rd substrate 32, and it is being airtightly fixed so that that heater part may be located in the crevice of the 1st substrate. N2 gas is enclosed on the occasion of seal of this crevice. 34 is an external electrode and is airtightly connected to the heater 33 through the electric insulation layer (not shown).

[0012] In the above-mentioned configuration, by the normal state, the 1st and 2nd breakthrough 26 and 27 is open for free passage through a gap 22, and the fluid passage which passes along Piping 30a and 30b is in the open condition. And if a power source (not shown) is connected to the external electrode 34 and a heater 33 is heated, N2 sealed by the crevice will expand. As a result, it bends, as a diaphragm 23 shows by the dotted line, and the 1st breakthrough 26 of a gasket 24 which countered the core mostly and has been arranged is blockaded, and passage will be in a close condition.

[0013] Drawing 2 is the sectional view showing other examples. Although the explanation which gives the same sign to the same element as drawing 1 , and overlaps in drawing is omitted Form comparatively larger crevice 21a shown with an alternate long and short dash line A in this example, and this crevice is etched further. It is comparatively alike, three small crevices 21b, 21c, and 21d are formed, and Gaskets 24a, 24b, and 24c are formed in each diaphragm 23a, 23b, and 23c. Moreover, in this example, it sticks to the outside of 3rd substrate 20a, Peltier device 40 is formed, and the heating (or cooling) means is constituted. 41 is a power source for heating a Peltier device (or cooling). In addition, N2 gas etc. is enclosed with Crevices 21a-24d also in this example. Moreover, it is also possible to establish the temperature detection means (not shown) which becomes the 1st substrate 20 which consists of a silicon single crystal from a PN junction, and to turn a power source 41 on and off according to the signal from the temperature detection means.

[0014] According to the above-mentioned configuration, it is possible to drive three diaphragms with one power source, and closing motion of three passage is possible at once. Moreover, the gap 22 of Gaskets 24a-24c and 2nd substrate 25a is adjusted suitably, if the temperature of N2 is controlled by the signal from Peltier device 40 and a temperature detection means, the bulb of normal closing can be realized, and it is possible to attain the dependability of the switching action of a bulb and improvement in the speed further.
[0015] In addition, this invention is not limited to the above-mentioned example. The volume seems for example, for what is necessary to be for Ar gas, halogen gas, neon gas, xenon gas, etc. to be used as an enclosure member, and to evaporate with heating and just to expand. Furthermore, the gap 22 may be arbitrary, without also restricting the number of the diaphragms which may form in the 2nd substrate side and are shown in drawing 2 to three, and the 2nd breakthrough may be two or more. Moreover, if the 3rd breakthrough 50 is formed in the 3rd substrate 32 as shown in drawing 3 , and the 1st and 2nd substrate 20 and 25 of a lot is already formed in an another side side, it is possible to open and close many bulbs further.
[0016]
[Effect of the Invention] As a means to drive a diaphragm according to this invention as concretely explained with the example above, it excels in long term stability by using the force by expansion of a gas, and the micro bulb which can drive simultaneously two or more bulbs with an easy configuration can be realized.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Industrial Application] This invention is used for the gas-passageway change of the micro gas chromatography formed for example, on the silicon substrate, and relates to a suitable micro bulb.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] Conventionally, the thing of the structure shown in drawing 4 indicated by publication of unexamined utility model application Heisei 1-154460 as this kind of a micro bulb in a cross section is known. In drawing 4 , 1 is the 1st substrate which consists of silicon, it is open for free passage to the crevice which the diaphragm which has the mesa section 6 is formed in the center section formed in this silicon substrate 1 of etching, and forms this diaphragm, and the slot 7 is formed. 2 is the 2nd substrate which consists of Pyrex glass, the breakthroughs 9 and 10 which serve as a gate of a fluid according to the location of the mesa section 6 and a slot 7 are formed, and the 1st and 2nd substrate is formed in piles of anode plate junction.
[0003] 4 is the supporter material of a cross-section U shape, covers the rear face of the mesa section 6 formed in the 1st substrate 1, and is being fixed by adhesives. 5 is an electrostrictive actuator (only henceforth an actuator), an end touches the pars basilaris ossis occipitalis of the supporter material 4, the other end touches the rear face of the mesa section 6 of the 1st substrate, and this actuator 5 is arranged. 12 is a power source for impressing an electrical potential difference to an actuator.
[0004] In addition, the thickness of the 1st substrate is about 6 micrometers, and the gap D of 0.3mm and the 2nd substrate is made into 4.2mm 2 and die length of about 9mm, and displaces about 8 micrometers of cross sections of an actuator with the electrical potential difference of 150V.
[0005] Since according to the bulb of the above-mentioned configuration a fluid flows from a breakthrough 9 and flows to a breakthrough 10 side, when the power source 12 of an actuator 5 is OFF, an actuator 5 develops when a power source 12 is ON, and the runoff hole 10 is blockaded by the mesa section 6, the bulb of a NOMARI open type is realizable.

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EFFECT OF THE INVENTION

[Effect of the Invention] As a means to drive a diaphragm according to this invention as concretely explained with the example above, it excels in long term stability by using the force by expansion of a gas, and the micro bulb which can drive simultaneously two or more bulbs with an easy configuration can be realized.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, since the above-mentioned conventional micro bulb has a very short expanding distance of an electrostrictive actuator, adjustment is difficult, and since the actuator is fixed by adhesion, when achieving the unification with the function of others further, such as concentration of a bulb, an actuation circuit, hydrometry, and a detector, which has a problem in long term stability, it is difficult [it] to form a bulb simultaneously with silicon ultra-fine processing technology. Moreover, since one driving gear is needed to each one bulb, there is a problem of becoming cost high. It was made in order that this invention might solve the trouble of the above-mentioned conventional technique, and as a means to drive a diaphragm, by using the force by expansion of a gas, it excels in long term stability and aims at offering the micro bulb which can drive simultaneously two or more bulbs with an easy configuration.

[Translation done.]

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MEANS

[Means for Solving the Problem] The 1st substrate with which, as for this invention, the crevice was formed in one field, and the diaphragm was formed in respect of this crevice and another side in order to solve the above-mentioned technical problem, The gasket of at least one shape of a ring fixed on said diaphragm, It has a predetermined gap in the side in which the diaphragm of said 1st substrate was formed. The 2nd substrate which has 2nd at least one through hole formed in the location which counters the periphery of the 1st breakthrough which has been arranged airtightly and formed in the location of said gasket which counters a core mostly, and a gasket, It has the 3rd substrate which covered said crevice and has been arranged airtightly, and while enclosing the member which expands with heating (or cooling) to said crevice (or contraction), it is characterized by establishing the heating (or cooling) means of this member.

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OPERATION

[Function] In the normal state, the 1st and 2nd breakthrough is open for free passage through a gap, and passage is in the open (or close) condition. If the member enclosed with the crevice of the 1st substrate is heated with a heating (or cooling) means (or cooling), a member will expand (or contraction). As a result, a diaphragm bends, the 1st breakthrough of a gasket which countered the core mostly and has been arranged is blockaded (or release), and passage will be in a close (or open) condition.

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EXAMPLE

[Example] This invention is explained using a drawing below. Drawing 1 is the sectional view showing one example of the micro bulb of this invention. In drawing, 20 is the 1st substrate which consists of a silicon single crystal, and the crevice 21 is formed in one field of this 1st substrate using anisotropic etching. One side of the gap with a depth of about several micrometers where 22 was formed in the another side side of the 1st substrate 20, and 23 is 100 micrometers - about 10mm and a diaphragm with a thickness of about 1-100 micrometers. 24 is the gasket of the shape of a ring which consists of nickel metallurgy with a micrometers [in thickness / several], and an outer diameter of 10 micrometers - about 1mm formed on the diaphragm, and is formed of vacuum evaporationo, a spatter, etc.
[0010] 25 is the 2nd substrate which consists of Pyrex glass, a silicon single crystal, etc., and the 1st breakthrough 26 is formed in the location which counters a gasket 24, and it is being airtightly fixed to this 2nd substrate 25 by the 1st substrate 20. The 2nd breakthrough which 27 was open for free passage in the gap 22, and was formed in the periphery of a gasket 24, and 30a and 30b are piping with a bore of about 0.1-1mm connected to the 1st and 2nd breakthrough 26 and 27.
[0011] 32 is the 3rd substrate which consists of Pyrex glass, a silicon single crystal, etc., the heater 33 which consists of a metal thin film resistor is formed in one field of this 3rd substrate 32, and it is being airtightly fixed so that that heater part may be located in the crevice of the 1st substrate. N2 gas is enclosed on the occasion of seal of this crevice. 34 is an external electrode and is airtightly connected to the heater 33 through the electric insulation layer (not shown).
[0012] In the above-mentioned configuration, by the normal state, the 1st and 2nd breakthrough 26 and 27 is open for free passage through a gap 22, and the fluid passage which passes along Piping 30a and 30b is in the open condition. And if a power source (not shown) is connected to the external electrode 34 and a heater 33 is heated, N2 sealed by the crevice will expand. As a result, it bends, as a diaphragm 23 shows by the dotted line, and the 1st breakthrough 26 of a gasket 24 which countered the core mostly and has been arranged is blockaded, and passage will be in a close condition.
[0013] Drawing 2 is the sectional view showing other examples. Although the explanation which gives the same sign to the same element as drawing 1 , and overlaps in drawing is omitted Form comparatively larger crevice 21a shown with an alternate long and short dash line A in this example, and this crevice is etched further. It is comparatively alike, three small crevices 21b, 21c, and 21d are formed, and Gaskets 24a, 24b, and 24c are formed in each diaphragm 23a, 23b, and 23c. Moreover, in this example, it sticks to the outside of 3rd substrate 20a, Peltier device 40 is formed, and the heating (or cooling) means is constituted. 41 is a power source for heating a Peltier device (or cooling). In addition, N2 gas etc. is enclosed with Crevices 21a-24d also in this example. Moreover, it is also possible to establish the temperature detection means (not shown) which becomes the 1st substrate 20 which consists of a silicon single crystal from a PN junction, and to turn a power source 41 on and off according to the signal from the temperature detection means.
[0014] According to the above-mentioned configuration, it is possible to drive three diaphragms with one power source, and closing motion of three passage is possible at once. Moreover, the gap 22 of Gaskets 24a-24c and 2nd substrate 25a is adjusted suitably, if the temperature of N2 is controlled by the

signal from Peltier device 40 and a temperature detection means, the bulb of normal closing can be realized, and it is possible to attain the dependability of the switching action of a bulb and improvement in the speed further.

[0015] In addition, this invention is not limited to the above-mentioned example. The volume seems for example, for what is necessary to be for Ar gas, halogen gas, neon gas, xenon gas, etc. to be used as an enclosure member, and to evaporate with heating and just to expand. Furthermore, the gap 22 may be arbitrary, without also restricting the number of the diaphragms which may form in the 2nd substrate side and are shown in drawing 2 to three, and the 2nd breakthrough may be two or more. Moreover, if the 3rd breakthrough 50 is formed in the 3rd substrate 32 as shown in drawing 3 , and the 1st and 2nd substrate 20 and 25 of a lot is already formed in an another side side, it is possible to open and close many bulbs further.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the cross-section block diagram of the micro bulb in which one example of this invention is shown.
[Drawing 2] It is the cross-section block diagram of the micro bulb in which other examples of this invention are shown.
[Drawing 3] It is the cross-section block diagram of the micro bulb in which other examples of this invention are shown.
[Drawing 4] It is the cross-section block diagram of the conventional micro bulb.
[Description of Notations]
20 1st Substrate
21 Crevice
22 Gap
23 Diaphragm
24 Gasket
25 2nd Substrate
26 1st Breakthrough
27 2nd Breakthrough
30 Piping
32 3rd Substrate
33 Heater
34 External Electrode
40 Peltier Device
41 Power Source

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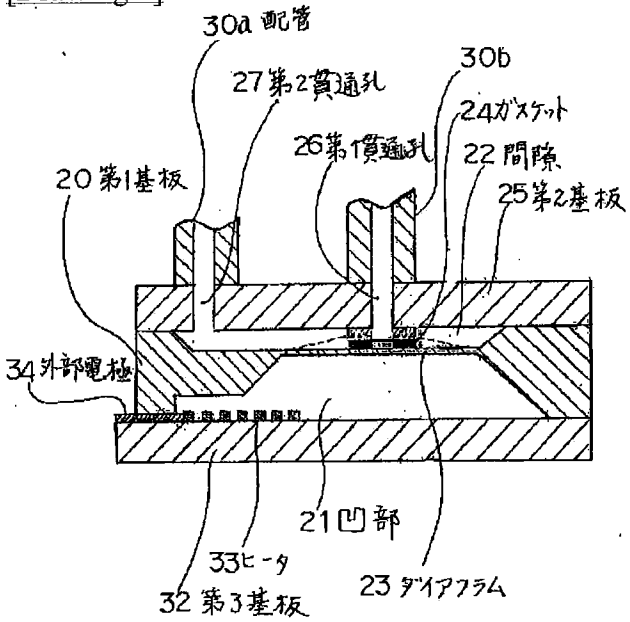
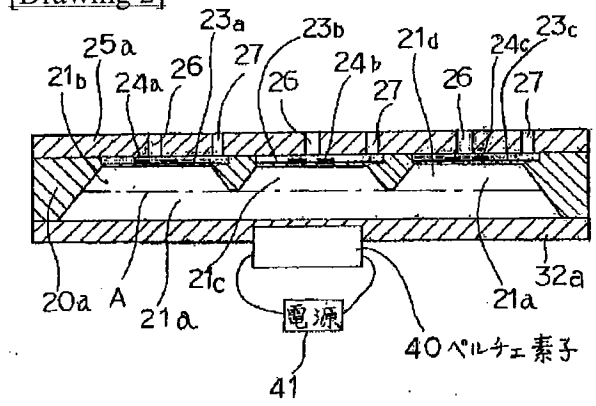
DRAWINGS

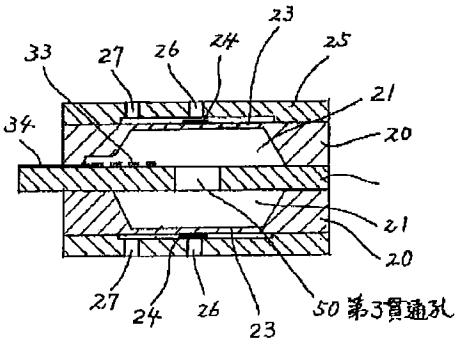
[Drawing 1]



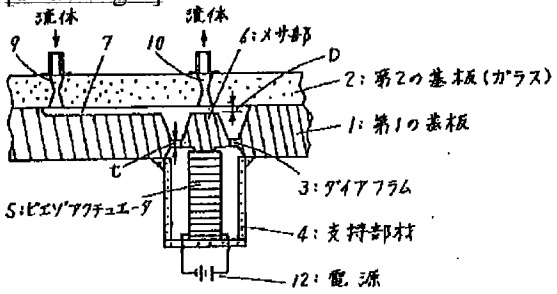
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]